March 11, 1941. M. N. NOLING 2,234,190

METHOD OF TYING FIGURE 8 KNOTS

Filed Dec. 17, 1938 2 Sheets-Sheet 1

Fig. 1.

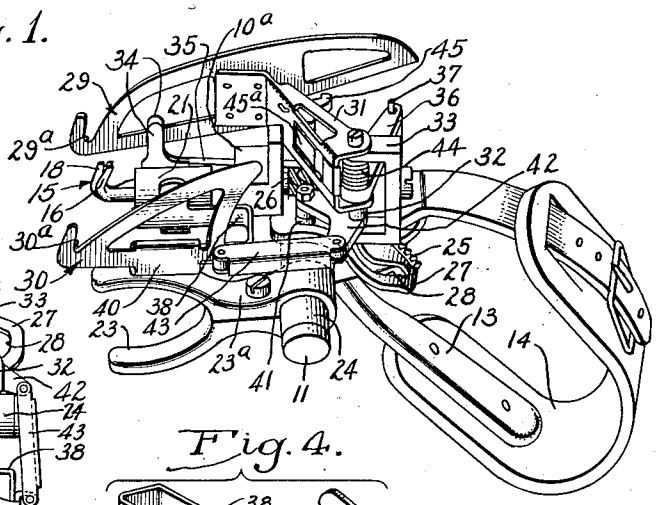


Fig. 2.

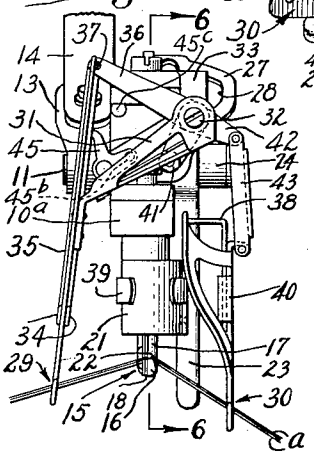


Fig. 4.

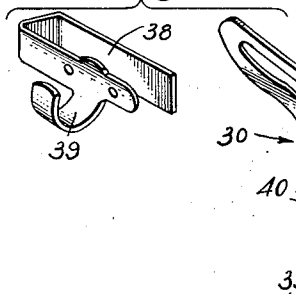


Fig. 5.

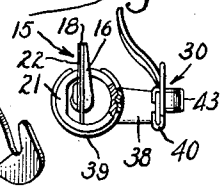


Fig. 3.

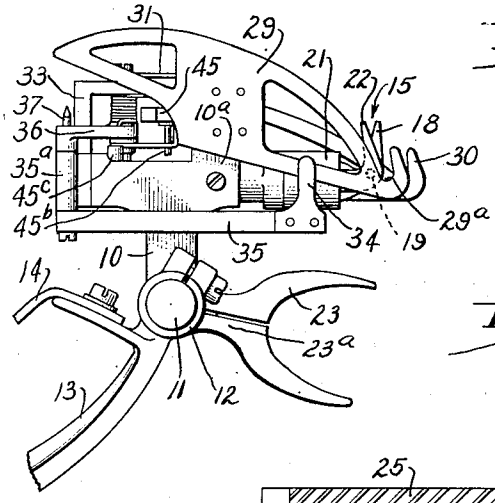


Fig. 6.

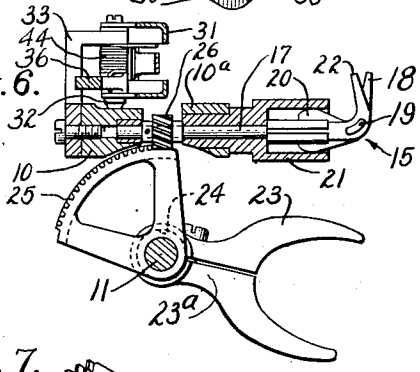


Fig. 7.

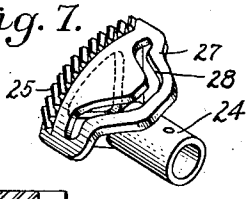
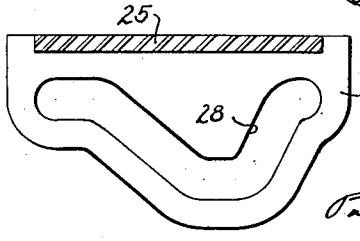


Fig. 8.



INVENTOR
Martin N. Noling
BY
Parker, Carlson, Hyman & Hubbard.
ATTORNEYS

March 11, 1941. M. N. NOLING 2,234,190

METHOD OF TYING FIGURE 8 KNOTS

Filed Dec. 17, 1938 2 Sheets-Sheet 2

Fig. 9.

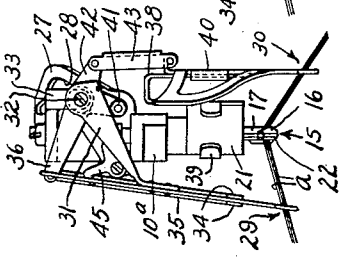


Fig. 10.

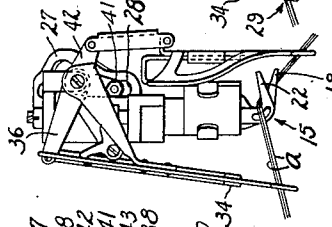


Fig. 11.

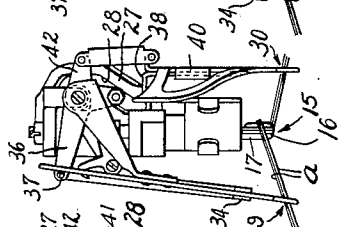


Fig. 12.

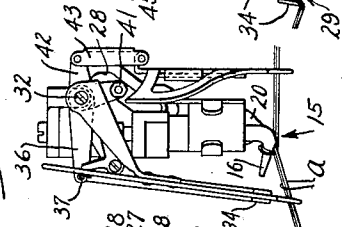


Fig. 13.

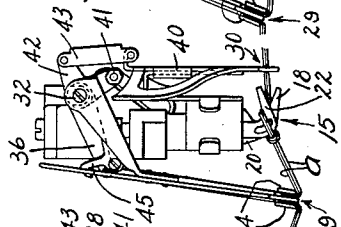


Fig. 14.

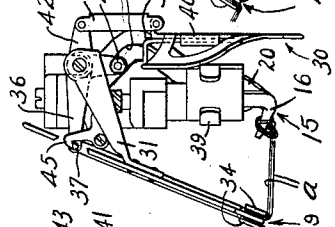


Fig. 15.

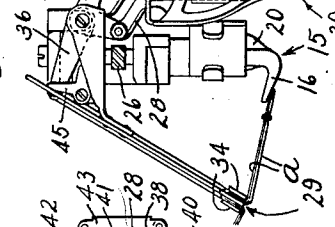


Fig. 16.



Fig. 17.



Fig. 18.



Fig. 19.

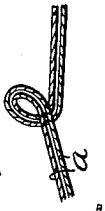


Fig. 20.



Fig. 21.



Fig. 22.



INVENTOR
Martin N. Noling
BY Parker, Carlson, Pierson & Hubbard
ATTORNEYS

Patented Mar. 11, 1941 2,234,190

UNITED STATES PATENT OFFICE

2,234,190

METHOD OF TYING FIGURE 8 KNOTS

Martin N. Noling, Rockford, Ill., assignor to Barber-Colman Company, Rockford, Ill., a corporation of Illinois

Application December 17, 1938, Serial No. 246,338

2 Claims. (Cl. 289—1)

The invention relates to an improved method of knot tying. I have herein shown a knotter or knot tying implement which is particularly adapted to carry out the method of knot tying which constitutes the present invention, but it should be understood that this knotter mechanism is described and claimed in my copending application Serial No. 291,482 filed August 23, 1939, which application is a division of the present application. In general, the knot tying mechanism shown in my said copending application is an improvement on that disclosed in Howard D. Colman Patent No. 755,110 issued March 22, 1904. Said Colman patent discloses a knotter or knot tying implement adapted to unite two or more strands of thread or yarn together by tying a so-called "round knot" in the strands.

The particular form of knotter illustrated in the Colman patent is arranged to be strapped to an operator's hand and actuated by a thumb fork or trigger. Although the method of knot tying herein disclosed has been illustrated as being carried out with a knotter which is also of this manually supported and digitally operated type, it should be understood that the present method may also be carried out with various other instrumentalities or by hand.

Knotters of substantially the form shown in said Colman patent have been used extensively for many years and with a high degree of success. In particular, they have been used by operators in textile mills for carrying out various thread tying operations such, for example, as to tie up broken threads, to tie a fresh bobbin thread to the strand being wound on a yarn spool in a spooling machine and for many similar thread tying operations required in the mill. The most extensive use of such knotters has heretofore been in cotton mills. In more recent years the increasing utilization of silk, rayon, celanese, and wool have brought new problems in knot tying. In uniting such materials it has been found that an ordinary round knot is likely to slip or become untied, especially during the jiggling and vibration to which the thread is subjected when passing through the harness and reeds of a loom. The present invention makes it possible to overcome this difficulty by uniting the threads with a figure 8 knot rather than a simple round knot, it having been found that a figure 8 knot formed in even silk, celanese, rayon or wool threads will remain firmly tied as the thread passes through a loom.

The general object of the present invention is to provide a novel method of knotting together a pair of threads by virtue of which a tight strong knot is formed between threads of even such materials as silk, rayon, celanese or wool, as well as cotton.

More specifically an object of the invention is to provide a novel method of forming a figure 8 knot in a pair of thread strands laid side by side in order to unite the same, this novel method of knot formation being of such character that it can be readily carried out by a mechanical knotter with great speed and precision, the latter characteristics being attributable in large measure to the fact that the initial positioning of the threads does not require any special looping or intertwining of them about the knotter bill or the like.

Further objects and advantages of the invention will become apparent as the following description proceeds, taken in connection with the accompanying drawings in which:

Figure 1 is a perspective view of a knotter adapted to carry out the improved method of knotting herein disclosed.

Fig. 2 is a plan view of the knotter of Fig. 1 with a pair of threads in place thereon preparatory to being tied.

Fig. 3 is a side elevation of the knotter of Fig. 1.

Fig. 4 is an exploded perspective view of one of the thread guides and its supporting bracket included in the device of Fig. 1.

Fig. 5 is a detail end elevation, partly in section, of the tying bill and its associated cam barrel together with one of the thread guides.

Fig. 6 is a vertical sectional view of the knotter.

Figs. 7 and 8 are respectively detail perspective and developed views of an actuating cam and segmental gear included in the knotter.

Figs. 9 to 15, inclusive, are stop-motion plan views of the knotter showing the position of the tying bill and threads in successive steps of the knot tying operation.

Figs. 16 to 22, inclusive, are diagrammatic views of the thread showing its successive positions during the tying of the knot and corresponding to the tying bill positions of the device shown in the complemental series of Figures 9 to 15, inclusive.

Figure 8 knots, as tied in single strands of rope or the like, have been known for many years. The general purpose of such a knot in a single strand was to form a bump or obstruction on it as, for example, to prevent the rope from being unreeved through a pulley. I have found that this figure 8 knot can be used advantageously to unite strongly and securely the ends of two or

more threads or similar small strands, by laying the threads side by side and tying them simultaneously in a figure 8 knot. Fig. 22 shows the completed knot.

In accordance with the present invention, an improved method is provided for tying a figure 8 knot. One particular virtue of this novel method is that it can be readily carried out by a mechanical knotter. Accordingly, my novel method of knot tying has been herein disclosed as carried out by a mechanical knotter, the particular mechanism chosen for purposes of illustration being that claimed in my copending application referred to above. As a preliminary to the explanation of the knotter mechanism and its operation in carrying out the knot tying method herein disclosed it will be useful to consider the several steps in the knot tying operation. Two or more threads *a* to be united are laid side by side and adjacent bights are placed in the knotter (Figs. 16 and 17). A loop is formed in these bights of thread with the threads crossed once at the bottom of the loop in what may be termed a singly twisted loop. (Fig. 19). Then the loop is turned through substantially 180° so as to form what may be termed a doubly twisted loop (Fig. 20). Thereafter the threads are snipped off adjacent the loop and the loop drawn over the sheared ends so that in effect the sheared ends are passed through the loop (Fig. 21). Finally, the knot is drawn tight, as shown in Fig. 22. It will be seen that one key step in this method of tying a figure 8 knot is the preliminary formation of a doubly twisted loop. Since this is the case, this method of knot tying can be readily carried out by the well known rotating bill type of knotter.

Turning now to the particular form of knotter illustrated (particularly Figs. 1, 2, and 3), the mechanism shown embodies an upright standard **10** having a transversely extending pin **11** fixed to its lower end. Adjustably fixed to one end of this pin **11**, by a split-sleeve clamp **12**, is an inverted L-shaped supporting handle **13**. A flexible strap **14** is secured to this handle **13** in such manner that it can be readily buckled about an operator's left hand to support the device while leaving the thumb of the hand free to actuate the knotter. This supporting arrangement is substantially the same as that shown, for example, in Fig. 1 of said Colman Patent No. 755,110.

In the formation of a figure 8 knot in accordance with my invention, the knotter utilized embodies a tying bill **15** which is rotated through two revolutions in each knot-tying operation, instead of one as in the case of tying an ordinary round knot. It is by this double revolution of the knot tying bill that the preliminary formation of a doubly twisted loop, noted above, is accomplished. In the knotted construction illustrated the tying bill embodies a fixed blade **16**, fashioned as an integral lateral extension on the outer end of a rotatable knotter shaft **17** (Fig. 6), and a cooperating movable shear blade **18**. The movable shear blade **18** is pivoted on the fixed blade **16** at **19**, and includes a butt end cam enlargement **20** fitted within a generally heart-shaped cam aperture fashioned in a nonrotatable cam barrel **21** (Figs. 5 and 6). This cam barrel is in turn secured to an extension **10a** on the standard **10**. A bill spring **22** presses the pivoted shear blade **18** against the fixed blade **16**.

As the knotter shaft **17** is rotated the tying bill **15** rotates and the jaws or blades **16** and **18** move to their open and closed positions in timed relation with the knotter shaft rotation. In particular, the contour of the interior of the cam barrel **21** is preferably such that beginning with the blades pointing upwardly (as shown in Figs. 6 and 9) the pivoted blade **18** swings from a partially open position to fully open position as the bill rotates clockwise (as viewed from the outer end) and is in general open through substantially 180° of rotation, after which it closes for the succeeding 180° of rotation. The tying bill construction is substantially like that shown in said Colman Patent No. 755,110 and, consequently further detail of description is believed to be unnecessary.

Rotation of the knotter shaft **17** is accomplished by means of a thumb fork or trigger **23** (Fig. 6). This fork is secured by a split sleeve clamp **23a** to a sleeve **24** (Figs. 1 and 7) journaled on the pin **11**. An enlarged head on the outer end of the pin **11** prevents endwise displacement of the sleeve **24**. Integral with the inner end of the sleeve **24** is a segmental gear **25** meshing with a skew pinion **26** (Fig. 6) fast on the knotter shaft **17**. Consequently, when the actuator fork **23** is oscillated downwardly, from the position shown in Fig. 6, the gear sector **25** causes the pinion **26**, and attached knotter shaft **17**, to rotate in a clockwise direction (as viewed from the tying bill end of the shaft). For a purpose which will hereinafter appear, an integral sector cam **27**, having a cam slot **28** therein (Fig. 7), is also fixed to the sector gear **25**.

Thread guides **29** and **30**, respectively, are provided on opposite sides of the tying bill **15** (Figs. 1 and 2). These guides may be economically fashioned as stampings from sheet metal and each embodies an upwardly facing hook-shaped end or thread engaging hook **29a** and **30a**, respectively. A plurality of threads *a* to be tied are laid across the tying bill and the thread guide hooks **29a** and **30a** (Fig. 2) and their end portions are tensioned forwardly away from the knotter so that the threads are seated in the bottoms of the guide hooks.

The thread guide **29** serves to locate the threads in proper angular relation to the tying bill **15** during the knotting operation and also serves to strip the threads from the tying bill in such manner as to complete the knot. This stripping operation is accomplished by clamping the threads in the guide **29** and then swinging it laterally away from the bill **15**. This positioning and stripping thread guide is of substantially the same construction as that shown in said Colman Patent No. 755,110 and, consequently, a detailed description is believed to be unnecessary. In general, it is sufficient for present purposes to note that the guide **29** is riveted or otherwise fixed to the outer end of a channel-shaped sheet metal supporting arm **31** (Fig. 1), which is in turn pivoted at its inner end by a pin **32** between the ends of a U-shaped bracket **33** screwed to the standard **10** (Fig. 6). Cooperating with the hook **29a** on the guide **29** is a pair of sheet metal clamping fingers (Figs. 1 and 3) fixed to the end of an arm **35**. This arm **35** is reciprocable generally longitudinally of the guide **29** so that the fingers **34** may be moved from the retracted position shown in Fig. 1 forwardly toward the nose of the hook **29a** to clamp the threads *a* against the same at the proper point in the tying operation. The arm **35** is carried at its inner end by supporting arm **36** (Fig. 3) journaled on the pin **32** and pivoted to the arm **35** by a pin

37 which extends through a sleeve extension 35a on the arm 35.

The second thread guide 30 serves to shift portions of the threads *a*, on its side of the tying bill 15, in timed relation with the rotation of the latter. As was previously noted, the tying bill blades 16 and 18 open during each revolution of the bill but, as will hereinafter appear, it is desirable in tying a figure 8 knot that the threads should be engaged between the blades only during the second revolution. To this end the guide 30 is arranged to have an initial projected position (Fig. 9), which it maintains throughout at least the first half revolution of the tying bill 15, and a retracted position (Fig. 12), which it occupies during substantially the remainder of the next succeeding revolution and a half of the tying bill. To support the guide 30 for such movement a generally U-shaped sheet metal bracket 38 is utilized (Fig. 4). This bracket embodies a laterally extending curved arm 39 which embraces the fixed cam barrel 21 and frictionally engages the same to hold the bracket in position as shown in Fig. 2. Integral ears 40 on the sheet metal thread guide 30 embrace the outer arm of the bracket 38 so that the thread guide is supported for reciprocation along this bracket arm.

Actuation of the thread guides 29 and 30 in timed relation with the rotation of the tying bill 15 is accomplished by means of the sector cam 27. A cam follower roller 41 (Fig. 1), carried by one end of a bell crank 42 journaled on the pin 32, projects within the slot 28 in the sector cam. The other arm of the bell crank 42 is connected to the thread guide 30 by a link 43 which is pivoted at its opposite ends to the thread guide and to the outer bell crank arm. Similarly, on the other side of the knotter the clamp fingers 34 are reciprocated along the thread guide 29 in timed relation with the rotation of the tying bill since the arm 36, which supports the arm 35, is fixed to the bell crank 42.

In order to cause the thread guide 29 to be swung laterally away from the tying bill while maintaining the fingers 34 in clamping relation with the threads in the hook 29a, a dog 45 (Fig. 3) is pivoted on the arm 31 and is yieldably urged by a flat spring 45a to a projected position in which it engages the upper end of the pin 37 when the latter is in its forward extremity of movement. Consequently, upon the return movement of the pin 37, during the oscillation of the arm 36, the dog 45 is engaged by the pin 37, thereby swinging the thread guide 29 outwardly about the pivot pin 32. This outward swinging of the thread guide continues until the pin 37 reaches substantially the extremity of the return movement at which time the dog 45 rides out of engagement with the pin by the contacting of the pin 45b with the stop member 45c. A helical spring 44, connected between the arm 31 and the arm 36 of the bell crank 42, snaps the thread guide back to its initial position.

In the rotation of the tying bill 15 through two revolutions, as above mentioned, it occupies successively the positions shown in Figs. 9 to 15, inclusive. The corresponding positions of the thread guides 29 and 30 are also shown in these figures.

To condition the knotter for operation, the operator shifts the thumb fork 23 to its uppermost position so that the tying bill 15 faces upwardly and the thread guide 29 is swung inwardly with the clamp fingers 34 retracted, while the thread guide 30 is in its projected position, all as indicated in Fig. 9. A pair of threads *a*, which are to be tied are then simply laid across the tying bill 15 as well as the thread guides 29 and 30, the threads being tensioned slightly at their ends so that they occupy substantially the position shown in Fig. 9. Thus no special intertwining or looping of the threads about the bill or other knotter parts is required. Then in order to tie a figure 8 knot to unit the threads all the operator need do is simply to depress the actuator fork 23.

Such a downward movement of the actuator fork 23 oscillates the sector gear 25 and sector cam 27 so that the tying bill 15 rotates in clockwise direction (as viewed from the bill and the knotter shaft). During the first 90° of tying bill rotation (Fig. 10) the blades 16 and 18 open but the threads *a* are not engaged therebetween since the guide 30 is in its projected position. A further rotation of the bill 15, to complete a total arcuate movement of substantially 270° from its starting position, completes a singly-twisted loop in the threads (Figs. 12 and 19).

During the initial part of the second revolution the blades 16 and 18 open as before but this time the thread guide 30 is retracted so that the bill blades receive between them the adjacent portions of the threads (Fig. 13). At the same time the clamp fingers 34 are slid forward so that they clamp the threads on the opposite side of the tying bill. It should also be noted that the further rotation of the tying bill has formed a doubly-twisted loop in the bights of the thread which it engages, as shown in Fig. 20.

In general the blades 16 and 18 of the tying bill 15 open and close in the same manner during both the first and second rotations of the tying bill. The thread guides 29 and 30 are actuated, however, only after the completion of substantially the first half revolution of the tying bill and their positions during the second revolution of the tying bill are substantially different than that during the first revolution. This result is accomplished by the particular shape given to the slot 28 in the sector cam 27. Upon reference to Fig. 8 it will be seen that during the initial movement of the cam 27 the cam follower 41 moves through a straight portion of the slot 28 so that no motion is imparted to the thread guide actuating bell crank 42. Thereafter, the cam follower 41 moves through a generally U-shaped portion of the cam slot 28 so that the bell crank 42 and attached arm 37 are oscillated from the position shown in Fig. 10 to that shown in Fig. 13 and finally back to that shown in Fig. 15.

After the threads have been engaged by the open tying bill blades 16 and 18 as shown in Figs. 13 and 18, continued rotation of the tying bill 15 moves the blades to close so that they shear off the threads *a* adjacent the tying bill and simultaneously clamp the sheared thread ends. Thereafter, the thread guide 29 is swung laterally from the position of Fig. 13 to that of Fig. 14 and finally to that of Fig. 15. During this swinging of the guide 29 the fingers 34 remain clamped against the threads so that the doubly-twisted loop is stripped from the tying bill 15. Also during this stripping action the blades 16 and 18 remain in gripping engagement with the sheared ends of the threads, so that the latter are drawn through the doubly-twisted loop in Fig. 21 and the knot drawn tight (Fig. 22). Upon such completion of the knot further rota-

tion of the tying bill 15 to its initial upright position partially opens the blades 16 and 18 whereupon the sheared ends of the knotted threads are disengaged. Furthermore, the thread guides 29 and 30 return to their initial positions and the fingers 34 disengage the threads so that the knotted threads may be freely removed from the implement.

From the foregoing it will be seen that a simple and effectual method has been provided for uniting a plurality of threads in a figure 8 knot. In view of the character of the various manipulatory steps required in carrying out this method, they can easily be accomplished with a mechanical knotter mechanism such, for example, as that herein shown so that it is readily adapted for use in textile mills and the like. By using such a figure 8 knot rather than, say, a round knot, the threads can be much more firmly secured together and inadvertent untying of the knot prevented, even though the threads be of such materials as silk, rayon, celanese or wool.

I claim as my invention:

1. The method of tying a figure 8 knot which comprises laying a pair of strands to be united transversely across the shank of a rotary tying bill having clamping and shearing blades so that the strands lie close to and extend approximately perpendicular to the blades of the bill, rotating the bill through approximately two revolutions and in each revolution causing the blades to open during the first portion of the revolution and to close during the latter portion thereof, initially positioning the parallel strands at the side of the bill toward which it is rotated so as to extend across the path of movement of both of the blades while the latter are in open position whereby in the first revolution the strands will be twisted about the bill, and shifting the strands so as to lie between the open blades for seizure thereby in the initial portion of the second revolution.

2. The method of tying a figure 8 knot which comprises laying a pair of strands to be united transversely across the shank of a rotary tying bill having clamping and shearing blades so that the strands lie close to and extend approximately perpendicular to the blades of the bill, rotating the bill through approximately two revolutions and in each revolution causing the blades to open during the one portion of the revolution and to close during a second portion thereof, during said one portion of the first revolution of the bill positioning the parallel strands at one side of the bill so as to extend across the path of movement of both of the blades while the latter are in open position whereby in the first revolution the strands will be twisted about the bill, and shifting the strands so as to lie between the open blades for seizure thereby in said one portion of the second revolution.

MARTIN N. NOLING.